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The Posterior Turn Over Vomerine Flap as a Primary Procedure During the Modified Two Flap Palatoplasty for Tension Free Multi-Layer Palatal Closure

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ABSTRACT

Cleft lip and/or palate are the most common congenital cranio-facial anomaly in humans and their treatment often requires multistaged and multidisciplinary management. In spite of the recently introduced modifications and refinements, the incidence of palatal fistula and velopharyngeal incompetence is still higher than satisfactory according to many reports. The junction between the hard and soft palate, being submitted to maximal tension during the repair is the commonest site of breakdown and fistulae formation. In addition, establishing and maintaining palatal length is an important factor in achieving velopharyngeal closure and thus, more normal speech. However, the degree of lengthening is usually limited by the deficiency of the mucosa on the nasal surface or the fibrosis resulting after its release. So, extra tissue to reinforce the nasal layer at the junction between the hard and soft palate is required.

This paper describes a technique that provides a relatively large mucoperiosteal flap harvested from the posterior part of the vomer based on its caudal free border. The flap is turned and sutured to the nasal mucosal layer, at the junction between the hard and soft palate, to substitute for the mucosal deficiency at this critical area thus providing a maintained palatal lengthening and eliminating the danger of dehiscence.

Sixty patients (37 males and 23 females with a mean age of 14.3 months, range 9-30 months) were operated upon using the two flap palatoplasty technique, as described by Salyer et al., with radical retropositioning of the velar musculature in conjunction with the use of posterior turn over vomerine flap for nasal lining, The mean follow-up was 1.1 years (from 3 months to 2 years). The results were assessed regarding the fistula rate, velopharyngeal valve competence and preliminary speech outcome. Three patients (5 percent) developed palatal fistula, two of the fistulas occurred at the junction of the hard and soft palates and one on the soft palate. The velopharyngeal closure and the preliminary speech results were satisfactory. Six patients (10 percent) had velopharyngeal incompetence and were expected to have pharyngoplasty. Five patients out of the 24 assessed for speech results developed moderate (3 patients) and severe (2 patients) degree of hypernasality.

In conclusion, despite study design limitations such as experience bias and short follow-up for speech assessment, this study demonstrated that the incorporation of the posterior turn over vomerine flap with the modified two-flap palatoplasty technique is effective in providing tension free multilayer palatal repair. It minimizes fistula occurrence at the junction of the soft and hard palates and may enhance palatal length with reduction of the need for secondary palatal surgery. This study provides valuable preliminary information as regard speech outcome but, longer follow-up speech and facial growth results are still needed.

INTRODUCTION

Cleft lip and/or palate are the commonest craniofacial anomaly in humans. Their treatment necessitates long term involvement of healthcare professionals, often requiring several operations and multidisciplinary management team **[1]**.

The goals of cleft palate repair are to separate the oral and nasal cavities, to provide a functional velopharyngeal mechanism for adequate speech development and Eustachian tube function and to minimize any detrimental effect on dento-maxillofacial growth **[2]**. Many techniques have been described to accomplish these goals, but there is still controversy over the type, timing and sequence of cleft palate surgical reconstruction **[3]**. The ideal surgical technique should address these goals by achieving a tension-free multilayer closure of the palatal defect with minimal dissection and a successful reconstruction of the levator muscle sling resulting in a functional velopharyngeal valve. Unfortunately, there is no perfect palatoplasty technique and efforts are still directed toward fistula rate reduction and speech outcome improvements **[4]**.

Palatal fistulas are a significant problem encountered by all surgeons who operate on the palate. The reported incidence of this problem varies widely from 0 to 63 percent **[5-8]** and recurrence after repair is common ranging from 37 to 50 percent **[5-9]**. Various factors have been implicated in the occurrence of cleft palate fistulas,

including the type of repair [10], the extent of clefting [7], the presence of an upper respiratory infection at the time of repair [11], sex and the surgeon performing the procedure [12]. In addition, the deficit of tissues especially in wide clefts makes the soft palate elongation difficult and despite a large dissection and releasing incisions, it can result in excessive tension on the repair line, which invites wound disruption [13].

The junction of the hard and soft palates is probably the most common site of breakdown. Since the deficiency of tissue involves mostly the nasal mucoperiosteum, the wound dehiscence is limited to the nasal layer and is not detectable from the oral side in the early postoperative period. Nonetheless, healing by second intention occurs with all its negative consequences. The force is exerted anteriorly by granulation and cicatrisation of the nasal defect, producing a shortening of the velum in the anteroposterior dimension. A similar harmful effect is produced by intended transaction of the nasal mucoperiosteum if it is not followed by resurfacing of the unepithelialized area [13].

Palatal lengthening is an important part of any palatoplasty procedure apart from closure of the defect and reconstruction of the levator sling. Though the role of the palatal push-back using a back-cut in the nasal lining has been debated, a large number of cleft surgeons still believe in the transverse division of the nasal mucosa for palatal lengthening [14]. Unfortunately, this creates a large defect in the nasal mucosa with a risk of secondary contraction and an eventual shortening of the palate again. This also restricts the mobility of the soft palate due to scarring, causing speech defects. Hence, it is well accepted that the raw area must always be closed to achieve a permanent lengthening of the palate [14]. Many ingenious procedures are introduced to close the nasal lining defect, including split-thickness skin graft [15], buccal mucosal graft [16,17], nasal mucosal flap [18,19], Z-plasty [20,21], primary pharyngeal flaps [22-24], mucoperiosteal island flap [25], buccal mucosal flap [26,27] and vomerine flap [13,28]. Although very useful and effective, the preceding methods are probably not faultless. In fact, such shortcomings as an impairment of bone nutrition, maxillary growth retardation, technical difficulties and damage to the sphincter resulting from the use of a flap from the back of the pharynx have been reported [13]. Taking this into consideration and in order to provide extra tissue to reinforce the nasal layer at the junction of the hard and soft palates, the posterior turn over vomerine flap have been adopted as a primary procedure for nasal lining to eliminate the danger of dehiscence and to provide maintained palatal lengthening. The rational for extension of the vomer flap was based on the excellent vascularization that permitted flap mobility on the narrow, twisted pedicle covering less than have the vomer width just proximal to the end of the hard palate [13].

In this study, a one-stage reconstruction of the soft and hard palates in complete clefts, using the modified two-flap palatoplasty technique has been used. This technique was first described by Bardach in 1967 [29] and further refined by Salyer et al. [30]. Radical intravelar veloplasty, described by Cutting et al. [31] and Sommerlad [32] has been demonstrated to decrease the need for secondary palatal surgery to levels below 10 percent and for this reason we decided to incorporate it as a part of the primary surgical treatment of our cleft palate patients. Consequently, the purpose of this article is to present results of two and half years experience using the two flap palatoplasty technique with radical retropositioning of the velar musculature in conjunction with the use of posterior turn over vomerine flap for nasal lining, with special emphasis on the fistula rate, VPI necessitating further surgery and preliminary speech outcome.

PATIENTS AND METHODS

A series of 60 patients with cleft palate (Veau types II, III and IV), aged from 9 to 30 months, were operated upon over the last 2.5 years by a single surgeon. Presence of a syndrome diagnosis was not a criterion for exclusion. All the patients underwent the modified two-flap palatoplasty described by salyer et al. [30], with intravelar veloplasty. The presurgical palatal length was measured according to Randall et al. [33] and in types I and II no back-cut in the nasal mucosa was done while, in types III and IV, lengthening by back cut in nasal layer was performed. Posterior turn-over vomerine flaps were performed for nasal lining in all the patients. The patients were assessed for incidence of oronasal fistula and VPI requiring further surgery, with a follow-up duration ranged from 3-24 months.

Palatal length estimation (According to Randall et al. [33]*):*

Palatal length was categorized as one of four types based on examination under general anesthesia before the initial surgery. The evaluations were done after endotracheal intubation with a Dingman mouth gag in place before injection with lidocaine and epinephrine. The head was moderately extended. Forceps were used to position the uvulae to

the posterior pharyngeal wall without stretching the tissue.

In type I, the distal tips of both uvulae easily reach the posterior pharyngeal wall. In type II, one or both uvulae only reach the posterior half of the adenoid pad. In type III, one or both sides of the uvulae reach only the anterior half of the adenoids and in type IV, one or both sides do not even reach as far as the adenoids.

Surgical technique:

The modified two-flap palatoplasty is performed as described by Salyer et al. **[30]**. Under general anesthesia and after one dose of antibiotic prophylaxis. Bilateral incisions are marked just lingual to the alveolar ridge. Incisions are also planned along the cleft margin to allow separation of the oral and nasal lining. Both markings are connected anteriorly, creating the round tips of the flaps. The palate is infiltrated with 0.5% lidocaine and 1:200,000 epinephrine.

The mucoperiosteal flaps are elevated starting at the lateral edges and proceeding to the cleft edge. The neurovascular bundles are identified and preserved. Then, subperiosteal undermining is carried along the posterior edge of the hard palate and onto the medial aspect of the pterygoid plate (space of Ernst). Further mobilization of the mucoperiosteal flaps in wide clefts can be achieved by dissecting the bundles from the flaps. Subperiosteal undermining is also carried out on the nasal surface of the palatine bones and maxilla, mobilizing the nasal mucosa off the palatal shelves, facilitating a tension-free closure. Attention is then turned to the soft palate muscle sling reconstruction. Complete dissection of the muscle from the posterior palatine border, the nasal and oral lining **[31,32]**. Thus, the levator muscle is freely mobilized, retrodisplaced and easily attains a transverse orientation **[4]**.

Vomerine flap elevation and multi-layer closure:

After dissecting the nasal mucosa from all its abnormal attachments along the cleft margin and posterior palate, the soft palate nasal mucosa of the two sides are sutured together posterior to the vomer. Effectively, a resultant defect is left at the junction of the hard and soft palates (Fig. 1). If a back cut is indicated to lengthen the velum as in types III and IV palatal length, the resultant defect will be wider (Fig. 2). A posterior turn over vomerine flap is used in all cases to allow an adequate closure of the nasal lining. The flap is raised from the free border of the vomer, based dorsally almost in the region of the nasopharynx. The design of the flap was made to cope with the defect dimensions and its base is, at least, as much as half of the vomer width. The flap is dissected, turned dorsally and interposed between the two edges of the nasal mucosa at the junction of the hard and soft palates (Fig. 3).

The remaining anterior part of the vomer tissue is used for repair of the nasal lining anteriorly. Either one side or two side flaps are raised according to the type of the cleft. These are sutured to the nasal mucosa of the lesser segment of the respective sides.

The muscles are then sutured as a separate layer with absorbable (vicryl 3-0) sutures.

The oral mucosa is closed with absorbable vertical mattress stitches. Anterior to the muscle repair, few vertical mattress sutures are used to plicate the oral lining against the nasal lining closure, to minimize the dead space.

The edges of the mucoperiosteal flaps are tacked to the edges of the palate whenever possible; usually in wide clefts, there is a minimal area of bare bone at the edges, which is covered with surgicell (Johnson & Jhonson, New Brunswick, N.J.) and tacked in place with absorbable sutures (Fig. 4). The patient is usually discharged home 2 days postoperatively, after ensuring patent airway.

Outcome measures:

The outcome of the described technique was measured by calculating the rates of the oronasal fistula development requiring subsequent closure and VPI requiring pharyngoplasty. The oronasal fistula was diagnosed clinically by direct inspection for the palatal suture line and the velopharyngeal closure was examined by nasopharyngeal fiberscope (Pentax portable pediatric naso-pharyngeolaryngoscope FNL-7RP3).

According to Karnell and Seaver **[34]**, assessment of velopharyngeal function has to achieve four goals: To assess structure, movement, extent and timing of closure. These findings are to be correlated with the perceptual judgment of the patient's speech. An overall appraisal of the velopharyngeal competence mechanism was given by the phoniatrician using a four point scale (0 (competent); 1 (borderline competent); 2 (borderline incompetent) and 3 (incompetent). The number of patients who recommended undergoing secondary palatal surgery for correction of VPI was recorded.

A preliminary speech evaluation was done in a small subset of patients (24 children) who reached above age 3 years by the end of the study. The

auditory perceptual assessment (APA) of the patient's speech is done by listening to the patient's utterance or recorded speech sample. Speech assessment is done by commenting on the degree and type of nasality (hypernasality), consonant precision, compensatory articulatory mechanisms, audible nasal emission of air, facial grimace and overall intelligibility of speech. All of the above elements are graded along a 4-point scale starting with 0 (normal) to 3 (severely affected) **[35]**. The clinical diagnostic aids comprise documentation of both the APA and documented visualization of the velopharyngeal port by the use of fiberoptic "flexible" nasopharyngolaryngoscope which is provided with a high intensity cold light and a special endoscopic television system for videotape recording **[35]**.

RESULTS

The general characteristics of the 60 patients who underwent the described technique are listed in Table (1). They were 37 males and 23 females, with a mean age at the time of repair of 14.3 months (range 9 to 30 months) and with associated syndrome in 5 (8.3%) of the cases. The mean follow-up after repair was 1.1 years (range 3 months to 2 years). The type of palatal defect was assessed using the Veau classification. Our study population included Veau types II, III and IV (complete cleft of the secondary palate, unilateral and bilateral complete cleft lip and palate, respectively). There was a male predominance across all cleft types, except for type II clefts, where there was a female predominance.

Table (1): General characteristics of the study group.

Type of cleft (Veau classification)	Number of patients	Male to female ratio	Mean age at repair, months	Oronasal fistula	VPI
Type II (Complete cleft of secondary palate)	13	5/8	–	0	1
Type III [UCLP (R+L)]	28	19/9	–	1	3
Type IV [BCLP]	19	13/6	–	2	2
Total number	60	37/23	14.3	3	6

The number of children who developed clinically significant oronasal fistulae requiring surgical closure was three (5%). Two of the fistulas occurred at the junction of the hard and soft palates and one on the soft palate. Of these three patients, two had bilateral cleft lip and palate (Veau type IV defect) and one had unilateral cleft lip and palate (Veau type III defect). Two of these children were males and one female, but all were non-syndromic patients. All the three patients developed moderate degree of velopharyngeal insufficiency and are scheduled for secondary surgery for fistula repair and pharyngoplasty.

The velopharyngeal closure and the preliminary speech results were satisfactory. Regarding flexible nasofibroscopic evaluation of the outcome of surgery, this revealed that (49) patients have competent velopharyngeal valve; (5) have borderline competent, (2) have borderline incompetent and (4) have incompetent velopharyngeal valve (Fig. 5). So, the number of children with VPI who was expected to need pharyngoplasty were 6 (10%), 5 of these patients were of type II and III wide defects.

Outcome was also assessed by analyzing the speech condition in a small subset of patients who were above age of 3 years by the end of the study; only 24 children were three years or more. Every child underwent an assessment for the hypernasality, an accurate, repeatable sign of VPI. The degree of hypernasality was graded from 0 to 3 [0 (normal); 1 (mild); 2 (moderate); 3 (severe)]. Five patients out of the 24 assessed developed moderate (3) and severe (2) degree of hypernasality with recommended pharyngoplasty (Table 2). The final speech results still need time to be fulfilled.

Table (2): Incidence and severity of hypernasality in a subgroup (24 patients).

Degree of hypernasality	Number of patients
0 (normal)	16/24
1 (mild)	3/24
2 (moderate)	3/24
3 (severe)	2/24
Not assessed	36

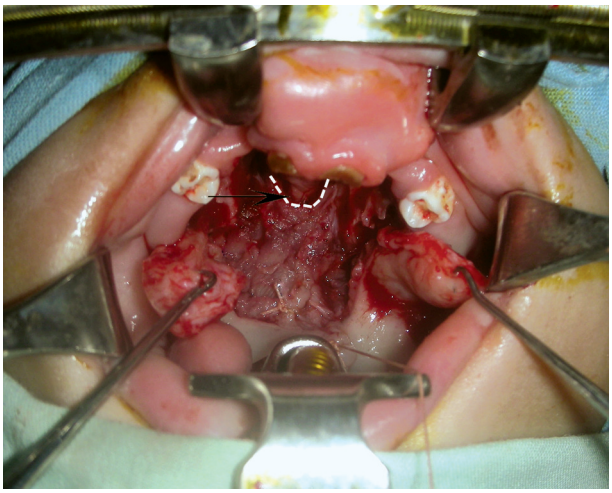

Fig. (1): Defect after closure of the nasal layer without back cut in, Veau type IV.

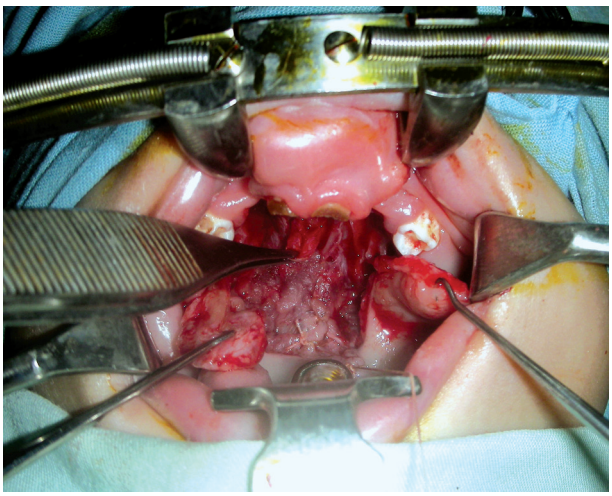

Fig. (3-A): Posterior turn over vomerine flap dissected to fill the defect (grasped by forceps).

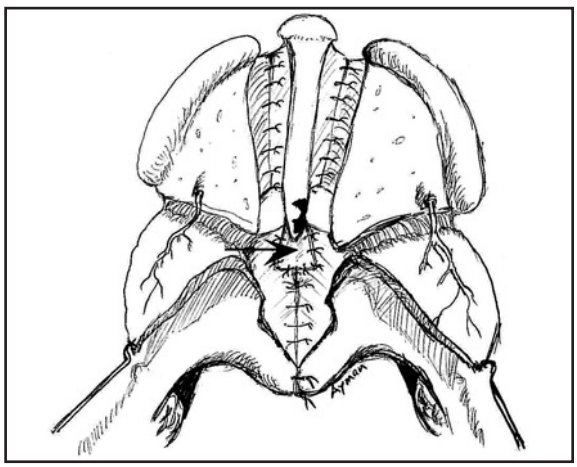

Fig. (3-C): Diagram to illustrate the dimensions and location of the previous flap.

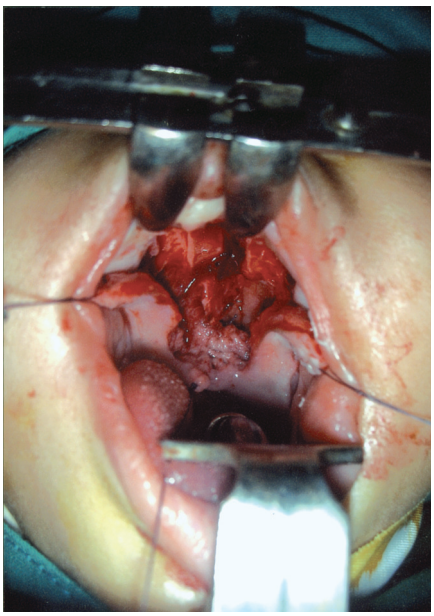

Fig. (2): Wide defect after back cut in nasal layer in one side in, Veau type III Cleft.

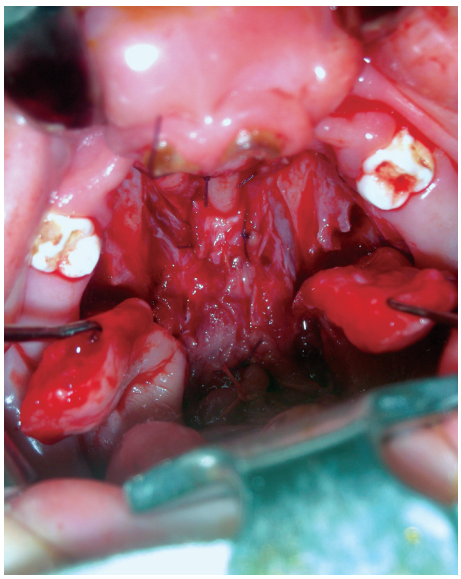

Fig. (3-B): Posterior turn over vomerine flap sutured in place.

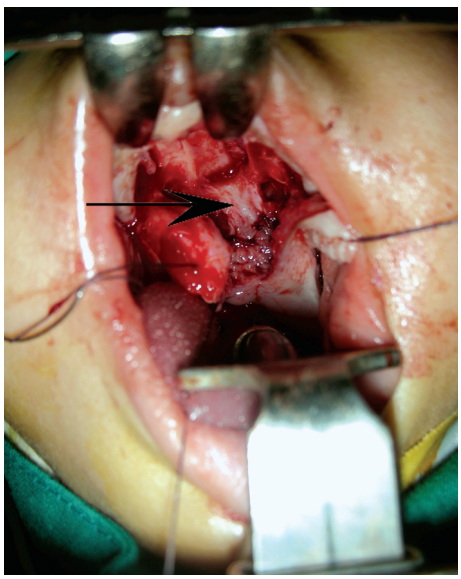

Fig. (3-D): Posterior turn over vomerine flap to fill wide defect after unilateral back cut in the nasal layer (not sutured).

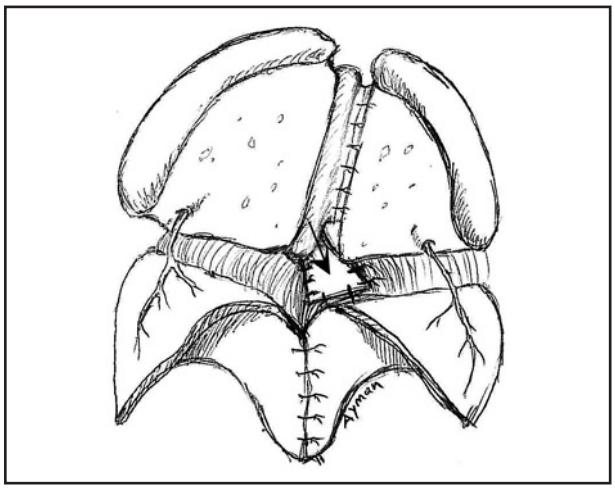

Fig. (3-E): Diagram to illustrate the dimensions and location of the previous flap.

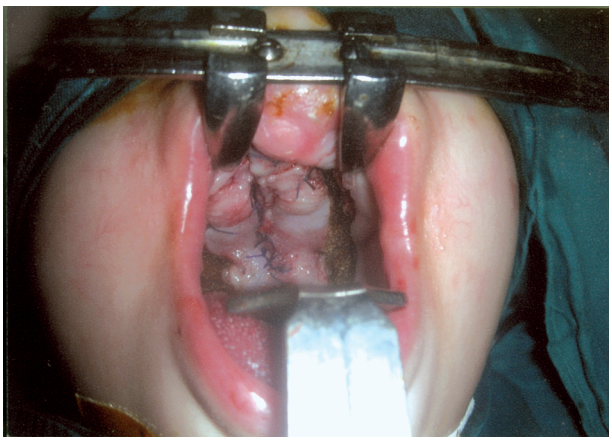

Fig. (4): A narrow area of bare bone at the edges, after complete closure filled with surgicell.

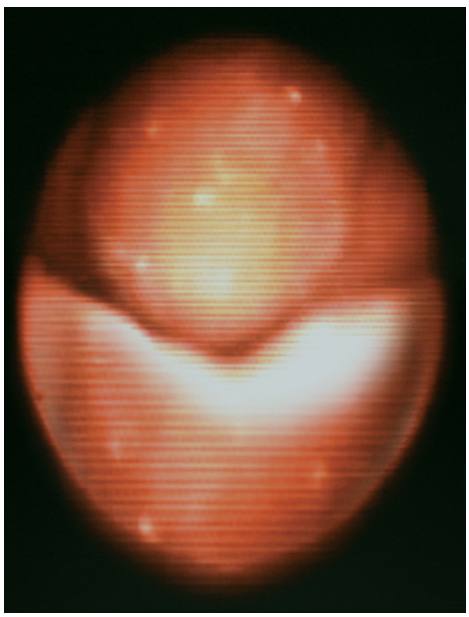

Fig. (5-A): Nasofibroscopy showing competent velopharyngeal valve, 6 months postoperatively.

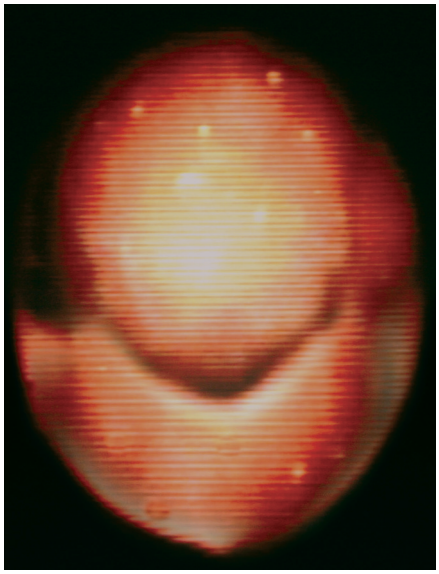

Fig. (5-B): Nasofibroscopy showing border line competent velopharyngeal valve, 6 months postoperatively.

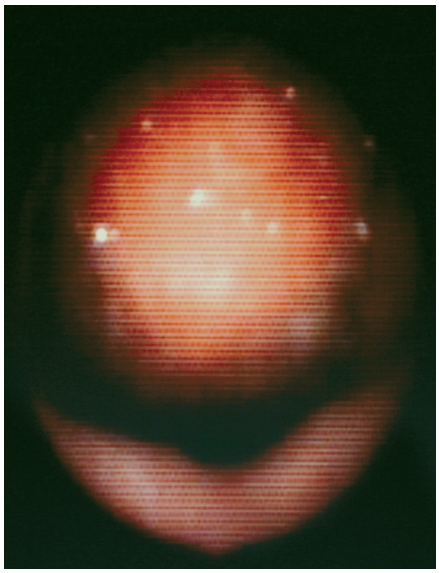

Fig. (5-C): Nasofibroscopy showing incompetent velopharyngeal valve, 6 months postoperatively.

DISCUSSION

The ideal surgical technique for repair of the palatal cleft is the subject of ongoing debate **[30]**. What surgical procedures to use and when to close the palatal cleft? were questions that had no universally acceptable answers **[36]**. In 1967, Bardach stressed the goals of tension-free closure of the entire palate at an early age (before 12 months). Moreover, he mentioned that the creation of a muscle sling was essential to speech, not only palatal lengthening **[29]**. The optimal age at which to perform palatal closure has been a matter of

controversy and requires weighing the benefits of speech development against the possible risks of disturbing facial growth. It has been long recognized that the palate should be repaired before 2 years of age. More recently an 18-month ceiling has gained wide acceptance. Dorf and Curtin **[37]** and others showed that closure by 12 months of age resulted in a better outcome. Several studies demonstrated improved speech development with palatal repair at an age earlier than 12 months **[3,29,30]**. Our preliminary speech results support these late findings as the mean age of the group examined for speech assessment were around the age of one year at time of repair. But it is highly likely that speech outcome following palatal repair is multifactorial and age of repair is but one variable. With respect to fistula formation, previous studies demonstrated a small difference between patients younger than 12 months and those between 12 and 25 months of age **[12]**, in our study there was no difference as regard the age with the incidence of fistulas as the three cases complicated by fistulae, their ages were 10, 12 and 26 months.

Although some authors have demonstrated that cleft patients have an intrinsic growth deficiency **[38]**, there is an ongoing controversy about the effect of palatal surgery on facial growth. The negative influence of surgical exposure and denudation of the hard palate on maxillary growth has been observed by several authors **[39,40]**. The technique of the two flap palatoplasty has the advantage of minimizing the area of exposed bone of the hard palate and thus there is little effect on the subsequent growth of the maxilla. Therefore, the two-flap palatoplasty theoretically has less potential to adversely affect maxillary growth as compared with 'push-back' procedures, but, further study of facial growth in our patient population is still required.

One of the main purposes of palate repair is to adequately close the palate and separate the oral and nasal cavities, avoiding oronasal fistula formation **[4]**. The two flap palatoplasty described by Bardach and Salyer et al. **[29,30]**, has been demonstrated to be a safe and reliable procedure to achieve this goal. It is an innovative combination of previously described techniques that provides a two-layer and a three-layer closure of the hard palate and soft palate, respectively. The round tip flaps based on the palatine vessels are extremely versatile in terms of their placement and can be easily shifted across the cleft and closed directly behind the alveolar margin when compared with the more classic V-Y push-back design **[41]**. This modification virtually eliminates fistulas in the anterior hard palate and dramatically reduces the overall fistula rate **[4]**. As the junction of the hard and soft palates represents the most common site of fistula occurrence due to closure under tension or incontinuity of the nasal lining, so, by augmenting this area with the described posterior turn over vomerine flap, this morbidity was eliminated to a great extent with more than 95% rate of healing by primary intention in this area. Our results demonstrated a low rate of clinically significant postoperative oronasal fistula development (5%) which is favorably comparable with the most recent reported studies **[1,8,30,42]**.

The other primary goal in palatoplasty is to provide an adequate velopharyngeal function with development of normal speech. Levator muscle repair is one of the key components of this technique and a fundamental element for achieving adequate speech results. Anatomical studies and clinical series support the principle of muscle sling reconstruction in primary palate repair **[43-45]**. The addition of intravelar veloplasty to classic techniques such as von-Langenbeck or push-back palatoplasty has been shown to significantly reduce the need for pharyngeal flaps **[46-48]**. In the two-flap palatoplasty described by Salyer et al. **[30]**, the muscle was completely dissected except from the oral mucosa. In the present study, we dissected the muscles from the palate, nasal and oral layers as described by Cutting et al. and Sommerlad **[31,32]** and the muscles were retropositioned in a more transverse orientation. Our satisfactory preliminary speech results support the relationship between speech outcome and aggressive muscle repair.

Furthermore, Morris et al. **[49]** reported that 80 percent of children who undergo a two-flap palatoplasty develop normal velopharyngeal function. In our study 90% of the children who underwent the modified technique with the posterior turn over vomer flap with and without back cut in the nasal lining, developed normal velopharyngeal competence.

One of the difficulties in cleft palate repair is that of establishing and maintaining sufficient palatal length in the initial repair. Adequate length is an important factor in achieving velopharyngeal closure and thus, more normal speech. With the use of Randall et al. **[33]** classification of palatal length, we can decide preoperatively which palates are likely to be short and incompetent postoperatively. So, in types III and IV with severe shortening of the velum, retrodislpacement of the velar muscles and back cut of the nasal layer for lengthening can

perform satisfactory velopharyngeal closure mechanism. One advantage of this system is that the classification depends only on the relationship of the soft palate to the adenoids and the posterior pharyngeal wall in a given patient; thus, regardless of the size of the patient or the depth of the pharynx, the system is relevant [33].

Although the idea of the two-flap palatoplasty technique is not to lengthen the palate as in the V-Y pushback, Bae et al. [50] demonstrated that retropositioning of the velar muscles in itself allows for some lengthening of the soft palate. Retrodisplacement of the soft palate by lengthening of the nasal mucosa using a back cut in the nasal lining is well established and the procedure is used by a large number of surgeons. Unfortunately, this creates a large defect in the nasal mucosa with a risk of secondary contraction and an eventual shortening of the palate again. This also restricts the mobility of the soft palate due to scarring, causing speech defects. Hence, it is well accepted that the raw area must always be closed to achieve a permanent lengthening of the palate [14]. Many methods of covering this raw area have been described [15-28], but all these techniques have its own shortcomings. As in most of cleft patients the vomer extends beyond the junction of the hard and soft palates, back to the adenoid tissue, this facilitates creation of a posterior turn over flap with good reach, which are sutured to the nasal lining, tethering it up in a more functional position. The use of various caudally or cranially based vomer flaps for the repair of a cleft palate has a rather long history [13,14,28,30,51]. The posterior vomer flap was initially described as a means to allow an adequate closure of the nasal defect created by transaction of the nasal mucosa in the push-back palatoplasty [13,14,51]. In the present study, the technique is a modification of existing techniques where the flap is raised from the dorsal free border of the vomer and based almost in the region of the nasopharynx. The shape of the flap was created according to the dimensions of the defect in the nasal mucosa. The emphasis in this technique is to perform tensionless closure of the nasal layer at the junction of the hard and soft palates where maximum tension is expected. If transaction was done for lengthening, still the flap is used for lining, to provide continuity of the nasal layer and to avoid the sequels of healing by secondary intention in this region.

The advantages from the use of this flap are that it is a simple procedure that can be done with routine primary palate operations, the reduction of tension at the junction of the hard and soft palates, a more effective and maintained lengthening of the velum and the flap is available in the vicinity of good vascularity [13]. Moreover, it is useful in the majority of cleft palate patients and it is possible to design the flap and to modify its dimensions as per the requirement.

The main disadvantage is that this flap is available only in patients who have a relatively large vomer which is free posteriorly [52]. A theoretical disadvantage of using vomerine tissue is that it may result in growth disturbance of the midface [13,28]. However, this has not been a problem after the use of this flap in anterior palatal closure [52] and resultant orthodontic problems are not different from that of a standard push-back [28]. There is ample long-term evidence indicating that its use is not detrimental to facial growth [36,53]. These vomer flaps have been used extensively for 17 years by Agrawal and Panda [14] and more recently by Salyer [30] and they did not notice any alarming hypoplasia in their patients. However, prospective anthropometric and cephalometric studies are required in order to substantiate this hypothesis.

So, considering the numerous advantages of vomer flaps, there should be no reservation regarding their use for the augmentation of the nasal lining, to reinforce the region between the hard and soft palate and to facilitate efficient velar lengthening. In conclusion, despite study design limitations such as experience bias and short follow-up for speech assessment, this study demonstrated that the incorporation of the posterior turn over vomerine flap with the modified two-flap palatoplasty technique is effective in providing tension free multilayer palatal repair. It can improve wound healing, minimize fistula occurrence at the junction of the hard and soft palates and may enhance palatal length with reduction to the need for secondary palatal surgery. This study provided valuable preliminary information as regard speech outcome but, longer follow-up speech and facial growth results still needed.

REFERENCES

1- Inman D.S., Thomas P., Hodgkinson P.D. and Reid C.A.: Oro-nasal fistula development and velopharyngeal insufficiency following cleft palate surgery-an audit of 148 children born between 1985 and 1997. B. J. Plast. Surg., 58: 1051, 2005.

2- Pigott R.W.: Objectives for cleft palate repair. Ann. Plast. Surg., 19: 247, 1987.

3- Rohrich R.J. and Byrd H.S.: Optimal timing of cleft palate closure: Speech, facial growth and hearing considerations. Clin. Plast. Surg., 17: 27, 1990.

4- Andrades P., Espinosa-de-los-Monteros A., Shell IV D.H. et al.: The importance of radical intravelar veloplasty during two-flap palatoplasty. Plast. Reconstr. Surg., 122: 1121, 2008.

5- Abyholm F.E., Borchgrevink H.H. and Eskeland G.: Palatal fistulae following cleft palate surgery. Scand. J. Plast. Reconstr. Surg., 13: 295, 1979.

6- Schultz R.C.: Management and timing of cleft palate fistula repair. Plast. Reconstr. Surg., 78: 739, 1986.

7- Cohen S.R., Kalinowski J., LaRossa, D. and Randall P.: Cleft palate fistulas: A multivariate statistical analysis of prevalence, etiology and surgical management. Plast. Reconstr. Surg., 87: 1041, 1991.

8- Wilhelmi B.J., Appelt E.A., Hill L. and Blackwell S.J.: Palatal Fistulas: Rare with the Two-Flap Palatoplasty Repair. Plast. Reconstr. Surg., 107: 315, 2001.

9- Rintala A.E.: Surgical closure of palatal fistulae: Follow-up of 84 personally treated cases. Scand. J. Plast. Reconstr. Surg., 14: 235, 1980.

10- Amaratunga N.A.: Occurrence of oronasal fistulas in operated cleft palate patients. J. Oral Maxillofac. Surg. 46: 834, 1988.

11- Musgrave R.H. and Bremner J.C.: Complications of cleft palate surgery. Plast. Reconstr. Surg., 26: 180, 1960.

12- Emory, Roger E. Jr., Clay R.P., Bite U. and Jackson I.T.: Fistula formation and repair after palatal closure: An institutional perspective. Plast. Reconstr. Surg., 99 (6): 1535, 1997.

13- Kobus K.: Extended vomer flaps in cleft palate repair: A preliminary report. Plast. Reconstr. Surg., 73 (6): 895, 1984.

14- Agrawal K. and Panda K.N.: Use of vomer flap in palatoplasty: Revisited. Cleft Palate-Craniofacial Journal, 43 (1): 30, 2006.

15- Baxter H., Drummond J.Jr. and Entin M.: Use of skin grafts in repair of cleft palate to improve speech. Arch. Surg., 59: 870, 1949.

16- Webster R.C.: Cleft palate II. Treatment. J.Oral Surg., 2: 485, 1949.

17- Spina V., Lodovici O., Pigossi N. and Faiwichow I.: Cleft palate elongation and mucous grafting in the open wound nasal area in a single operative stage. Rev. Lat. Am. Cir. Plast., 5: 21, 1961.

18- Cronin T.D.: Method of preventing raw area on nasal surface of soft palate in pushback surgery. Plast. Reconstr. Surg., 20: 474, 1957.

19- Stark D.B.: Nasal lining in partial cleft palate repair. Plast. Reconstr. Surg., 32: 75, 1963.

20- Champion R.: Some observations on the primary and secondary repair of the cleft palate. Br. J. Plast. Surg., 9: 260, 1957.

21- Edgerton M.T.: Surgical lengthening of the cleft palate by dissection of the neurovascular bundle. Plast. Reconstr. Surg., 29: 551, 1962.

22- Dibbel D.G., Laub D.R., Jobe R.P. and Chase R.A.: A modification of the combined push-back and pharyngeal flap operation. Plast. Reconstr. Surg., 36: 165, 1965.

23- More F.T.: A new operation to cure nasopharyngeal incompetence. Br. J. Surg., 47: 424, 1960.

24- Webstar R.C., Quigley L.F., Coffey R.J., Querze R.H. and Russell J.A.: Pharyngeal flap staphylorrhaphy and speech aid as a means of avoiding maxillofacial growth abnormalities in patients with cleft palate. Am. J. Surg., 96: 820, 1958.

25- Millard D.R. Jr.: The island flap in cleft palate surgery. Surg. Gynecol. Obstet., 116: 297, 1963.

26- Mukherji M.M.: Cheek flap for short palates. Cleft Palate J., 6: 415, 1969.

27- Kaplan E.N.: Soft palate repair by levator sling reconstruction and buccal mucosal flap. Plast. Reconstr. Surg., 56: 129, 1975.

28- Kumar P.A.V.: The use of vomerine flap for palatal lengthening: The modified Nagpur technique. Br. J. Plast. Surg., 38: 343, 1985.

29- Bardach J.: Two-flap palatoplasty: Bardach's technique. Oper. Tech. Plast. Reconstr. Surg., 2: 211, 1995.

30- Salyer K.E., Sng K.W. and Sperry E.E.: Two-flap palatoplasty: 20-year experience and evolution of surgical technique. Plast. Reconstr. Surg., 118: 193, 2006.

31- Cutting C., Rosenbaum J. and Rovati L.: The technique of muscle repair in the cleft soft palate. Oper. Tech. Plast. Reconstr. Surg., 2: 215, 1995.

32- Sommerlad B.C.: A technique for cleft palate repair. Plast. Reconstr. Surg., 112: 1542, 2003.

33- Randall P., LaRossa D., McWilliams B.J., et al.: Palatal length in cleft palate as a predictor of speech outcome. PRS, 106 (6): 1254, 2000.

34- Karnell M.P. and Seaver E.: Measurement problems in estimating velopharyngeal function. In: Bardach J., Morris H.L., editors. Multidisciplinary Management of Cleft Lip and Palate. Philadelphia: WB Saunders, p. 776-86, 1990.

35- Kotby M.N., Emad K. Abdel Haleem, Mona Hegazi, Ikram Safe and Mohamed Zaki: Aspects of assessment and management of velopharyngeal dysfunction in developing countries. Folia Phoniatrica et Logopedica, 49: 139, 1997.

36- La Rossa D.: The State of the Art in Cleft Palate Surgery. The Cleft Palate-Craniofacial Journal, 37 (3): 225, 2000.

37- Dorf D. and Curtin J.: Early cleft palate repair and speech outcome: A ten year experience. In: Bardach J., Morris H., eds. Multidisciplinary Management of Cleft Lip and Palate. WB Saunders, 1990.

38- Brusati R. and Mannucci N.: Repair of the cleft palate without lateral release incisions: Results concerning 124 cases. J. Cranio-maxillofac. Surg., 22: 138, 1994.

39- Pigott R.W., Albery E.H., Hathorn I.S., et al.: A comparison of three methods of repairing the hard palate. Cleft Palate Craniofac. J., 39: 383, 2002.

40- Friede H., Enocson L., Moller M. and Owman-Moll P.: Maxillary dental arch and occlusion in repaired clefts of the secondary palate: Influence of surgical closure with minimal denudation of bone. Scand. J. Plast. Reconstr. Hand Surg., 34: 213, 2000.

41- Hoffman W.Y. and Mount D.: Cleft palate repair. In S.J.

Mathes (Ed), Plastic Surgery, Vol. IV. Philadelphia: Saunders, p. 248, 2007.

42- Bekerecioglu M., Isik D. and Bulut O.: Comparison of the rate of palatal fistulation after two-flap and four-flap palatoplasty. Scand. J. Plast. Reconstr. Surg. Hand Surg., 39: 287, 2005.

43- Kriens O.B.: An anatomical approach to veloplasty. Plast. Reconstr. Surg., 43: 29, 1969.

44- Ruding R.: Cleft palate: Anatomic and surgical considerations. Plast. Reconstr. Surg., 33: 132, 1964.

45- Braithwaite F. and Maurice D.G.: The importance of the levator palati muscle in cleft palate closure. Br. J. Plast. Surg., 21: 60, 1968.

46- Dreyer T.M. and Trier W.C.: A comparison of palatoplasty techniques. Cleft Palate J., 21: 251, 1984.

47- Trier W.C. and Dreyer T.M.: Primary von Langenbeck palatoplasty with levator reconstruction: Rationale and technique. Cleft Palate J., 21: 254, 1984.

48- Hassan M.E. and Askar S.: Does palatal muscle reconstruction affect the functional outcome of cleft palate surgery? Plast. Reconstr. Surg., 119: 1859, 2007.

49- Morris H.L., Bardach J., Jones D., et al.: Clinical results of pharyngeal flap surgery: The Iowa experience. Plast. Reconstr. Surg., 95: 652, 1995.

50- Bae Y.C., Kim J.H., Lee J., Hwang S.M. and Kim S.S.: Comparing study of the extent of palatal lengthening by different methods. Ann. Plast. Surg., 48: 359, 2002.

51- Kobus K.: Extended vomer flap in the early repair of a cleft palate. Scand. J. Plast. Reconstr. Surg., 21: 95, 1987.

52- Horton C.E., Irish T.J., Adamson J.F. and Miadick R.A.: the use of vomerine flaps to cover the raw area on the nasal surface in cleft palate pushbacks-Preliminary report. Plast. Reconstr. Surg., 51 (4): 421, 1973.

53- Abyholm F.E., Borchgrevink H.C. and Eskeland G.: Cleft lip and palate in Norway. III. Surgical treatment of CLP patients in Oslo 1954-75. Scand. J. Plast. Reconstr. Surg., 15: 15, 1981.